habits of the spider, it would seem to be well enough accounted for as the result of excess of vigour or vital force belonging to the stronger or male sex. The action of natural selection would operate here also, indirectly, and these and other similarly excessive developments would only be checked when they tended to become, or became (as in some cases they indeed appear to have nearly become), positively detrimental, or at any rate disadvantageous, to the sex. The senses of spiders—"smell," "hearing," and "touch"—are then gone into. In connection with the sense of "hearing," various stock stories about spiders and the effect of musical sounds upon them are detailed; but such small credit is attached to them as relating facts on which any scientific conclusions can be based, that it would hardly seem to have been worth while to swell an already bulky volume by their repetition. Chapter x. of part iv. ends with the details of the stridulating power of some spiders and its probable purpose. Chapter xi., on the colour, and colour-sense, brings part iv. to a conclusion. The more brilliant colouring and ornamentation of the male spider, in some groups, is accounted for by the preference supposed to be given on the part of the female to males thus ornamented. But it does not appear that this preference is yet proved in any instance as a fact; nor can it be fairly argued that, because sexual excitement often leads the male to display it in curious antics and contortions, it therefore follows that the female is in the least influenced by it; whereas in fact, as she is stated to be (p. 63), the female is generally an unmoved spectator. Doubtless the male frequently succeeds in his purpose after such displays—*post hoc* certainly, *sed non propter hoc*. The author having come to the conclusion that the female prefers the male for his bright colours, we are not surprised to find it argued, conversely, that in those groups where it is the female sex which is the largest and bears the brightest hues, it is the less gaudy male who is helped and influenced in his choice by the increased size and excessive coloration of the female. The argument here also does not appear to have more real weight than in the former case, if even so much. On the subject of adaptation of the colouring of spiders to their surroundings and its beneficial effect, the opinion is expressed that, considering the great exposure to enemies of numbers of brilliantly coloured and conspicuous spiders, no generalization is yet warranted. No weight seems here to be given to the supposition that some of these exposed spiders may be distasteful as food; while it is admitted that many, as those of the genera *Gasteracantha* and *Acrosoma*, are protected by their spiny armature, and, it may be added, by their generally hard integument. The theory of "warning colours" is dismissed as inapplicable to spiders. Adopting the experiments of Sir John Lubbock and Mr. and Mrs. Peckham, spiders are considered to possess a sense of colour; but when we are told that a test case was afforded by a spider whose eyes had been purposely blinded with paraffin, our confidence in the result of these experiments will perhaps be a little shaken; since it is gravely argued from this test case that, because a blind spider exercised no apparent choice of one colour over another, this proves that the apparent preference of a spider before blinding was a true choice, and that there exists a colour-sense in certain spiders. Chapter xii. of part v. is on that most interesting part of natural history in all its departments—resemblance to other objects both inanimate and animate, with the causes and consequences of the resemblance. Space will not permit us to follow the author in the details of this part of his subject. The chapter will be read with pleasure and interest by most observers; but we may perhaps remark that there is at times an apparent tendency to take inability to perceive any resulting advantage from the resemblance as a proof that the resemblance is not the result of natural selection.

Chapter xiii. of part v. treats of the enemies of spiders, and their influence on habit. This subject is, of course, closely connected with protective resemblance; and by no means the least interesting part of this chapter is the account of some truly parasitic spiders—*Mimetus interfector* and others. These take up their abode in the webs of other spiders, and after eating the rightful owner, regale themselves at leisure upon its eggs and young. Part v. ends with chapter xiv., on "Death and its Disguises; Hibernation, and Death feigning." Natural death may be almost said to be an unnatural event in the history of most of the creation, excepting man; but perhaps more frequent instances of it are seen by the entomologist and araneologist, than by other naturalists. Some of our British *Drassidæ*, in the genus *Clubiona* for instance, may often be found sewn up in a nest of leaves drawn together, with their egg-sac, brooding over it, in various stages of lethargy, sometimes so shrivelled and comatose as to be almost incapable of movement. These spiders probably drop to the earth with the opening of the nest for the exit of the young, and at once die when their progeny begin to live. The author gives interesting details of a similar kind in reference to spiders of the family *Epeiridæ* far removed from the *Drassidæ*, and we have also noted it in another family equally remote from both, *Thomisidæ*. "Death feigning" is considered to be perfectly voluntary, though perhaps developed out of an original state of "fright-paralysis"; contrary to the opinion and explanation given by Darwin of this habit. The concluding part of the book, part vi., contains an account of fossil spiders, a subject which, though bearing very little upon the "spinning work of spiders," has a very strong and an increasing interest of its own. It appears to be well treated in the twenty-three pages here devoted to it. We cannot leave this necessarily very incomplete notice of Dr. McCook's bulky volume without drawing especial attention to the numerous (401) woodcuts, and the coloured plates, with which it is so profusely and usefully illustrated. The greater part of these are engraved from the author's own original drawings, and evidence a skill as well as a power of patient observation scarcely equalled in any contemporary work on natural history.

O. P. C.

MR. BASSET'S ELEMENTARY TREATISE ON HYDRODYNAMICS AND SOUND.

An Elementary Treatise on Hydrodynamics and Sound. By A. B. Basset. (Cambridge: Deighton, Bell, and Co. London: George Bell and Sons. 1890.)

WHEN the Senate of the University of Cambridge decided to adopt the suggestion of the Special Board for Mathematics to include the elements of hydrodynamics and the theory of sound among the subjects of Part I. of the Tripos, teachers of these subjects naturally looked to Mr. Basset to provide a text-book that should meet the wants of students preparing for the examination, and he has responded to the demand with great promptitude. The present treatise is designed, he tells us, for those who are reading for this examination and others in which a knowledge of these subjects is required. If the purpose of the book had been different—if, for instance, it had been written as a purely scientific training for hydraulic engineers, or for use in a physical laboratory —it would have had to be conceived in a very different vein. We should have looked for full explanations of elementary concepts, frequent appeals to experiment, constant arithmetical interpretation of the analysis, and a large proportion of physical reasoning. If, however, the book is to be judged by the standard it aims at, it must be regarded as an admirable specimen of an examination book. The propositions are clearly set out in a methodical order. They are isolated from each other as much as possible, and proved individually by the use of appropriate principles. The examples are for the most part well chosen, and calculated to initiate the student into a great variety of the tips and dodges with which the examiners are likely to be familiar; and no more is generally given than would be useful in writing out bookwork and solving problems.

We proceed to a detailed account of the work.

The treatise is divided into two parts, of which the first deals with hydrodynamics, and the second with the theory of sound. In the first part there are five chapters. Chapter i. treats of the kinematics of fluids and of the general equations of motion. We are glad to see that the author has given prominence to the "flux method," and has had the courage to restore the elementary parallelepiped which Prof. Greenhill affects to despise; for the purposes of an elementary treatise the value of this artifice is too great to be lost. Very welcome also is the proof of the important principle at the foot of p. 11, first stated exactly in the larger treatise, vol. ii. p. 234, and apparently due to Prof. Greenhill ("Encyc. Brit.," Art. "Hydromechanics"). We could wish that the theory of the bounding surface had been as fully explained. The same chapter i. contains a short account of sources, doublets, and images, and electric and magnetic analogies are given which add much to the usefulness of these sections.

Chapter ii. treats of the motion of a sphere and of the motion of certain cylinders in an infinite fluid. The descent of the sphere under gravity is very nicely worked out, the usual ambiguity being avoided by explicitly introducing the distance of the centre from a fixed horizontal plane. The resultant pressure on the sphere is calculated, and the equations of motion deduced from Newton's second law. The chapter concludes with an interesting account of the resistance of a liquid to the motion of a spherical pendulum. This chapter contains an exception to the general plan of the work. Mr. Basset appears to write hydrodynamics *con amore*, and cannot always be restrained from trying to teach the student something which he will not be called upon to write out. We refer to his account of recent researches in the theory of the resistance of viscous fluids.

Chapter iii. is occupied with the theory of the motion of a single solid in an infinite liquid. This part of the subject is less elementary than the others which are treated in the book, inasmuch as the machinery of moving axes has to be introduced. The author has cleverly avoided the use of Lagrange's equations and Routh's method of ignoration of co-ordinates, but it must be confessed that it is sometimes a little difficult to see how some of the terms in the equations are obtained by means of the principles invoked. The student may well be puzzled to account for the term $-M'g$ in the equation of motion of the sphere on p. 69. The most interesting problem discussed in the chapter is that of the motion of an elliptic cylinder. Drawings of the path of the centre of gravity in the three cases of oscillation, revolution, and just complete revolution, are given. In the first case, the path looks something like an orthogonal projection of a curve of sines, and the cylinder moves so as to have turned through the maximum angle when the centre is at an inflexion; it then turns back, and the angle described goes through a periodic oscillation while the cylinder moves over a wave-length. In the second case, the path looks like a nodal trochoid, and the cylinder makes one complete revolution in the time taken to pass from a node to the next consecutive node but one. In the third case, the path looks like a nodal cubic with an inflexion at infinity. The cylinder moves from infinity with its major axis initially parallel to the asymptote; at the furthest extremity of the loop it has turned through a right angle, and it then goes off to infinity in the opposite direction, and only turns through two right angles in the whole length of its path. Other interesting things in the chapter are the application of the theory of helicoidal steady motion to explain the necessity of rifling guns, and the theory of the motion of a cylinder in a fluid bounded by a fixed rigid plane, leading to the suggestion of the realization of "action at a distance" by means of fluid pressure.

Chapter iv. is devoted to liquid waves. All the elementary problems are treated very elegantly. "Long waves" are in the first place regarded as a particular case of progressive harmonic waves, and the "exact theory" of long waves in a canal comes afterwards. This seems to us the most natural order. Another point of interest is the discussion of a case of instability, due to Lord Rayleigh. Mr. Basset has done well all through to insist upon the importance of investigations relating to stability.

Chapter v. is occupied with the theory of rectilinear vortices. The vortex line is treated as an ideal limit of a vortex cylinder, and some cases in which the cylinder is of finite section are discussed. We think it unfortunate that in treating the elliptic vortex cylinder the value of the constant D is not given, as it is directly proportional to the circulation; but the student reading the section is certain to take it to be an arbitrary constant. The simplest cases of motion of a straight vortex in a bounded space are treated by the method of images. The chapter concludes with new proofs of Helmholtz's celebrated "laws of vortex motion." A brief account of Sir W. Thomson's theory of "vortex atoms" would have been of interest here.

Part ii. of the treatise deals with the theory of sound, and contains five chapters. The first of these (chapter vi.) is intoductory, and explains the relation of musical notes to the vibrations of bodies, and the connection be tween sound and the propagation of waves in air. It is admirable rather for conciseness than for completeness of exposition.

Chapter vii. is occupied with the vibrations of strings and membranes, nearly the whole of it being devoted to transverse vibrations of strings. The method of acoustics is adopted, as developed in Lord Rayleigh's treatise. It consists in assuming the motion to be periodic, and dependent upon a function called a normal function, in a series of which arbitrary functions can be expanded. Mr. Basset has changed the nomenclature, so that the "normal co-ordinate" of Lord Rayleigh is here called a "normal function." Is this intentional? The method adopted dispenses with the necessity of proving Fourier's theorem. Other things in this chapter worthy of note are the formation and discussion of the equation of motion for a string subject to viscous resistance and under the action of a periodic force, leading to a particular illustration of the well-known theory of forced vibrations.

Chapter viii. is occupied with the theory of the vibrations of bars. It opens with an account of the stress in a bent bar, and we have here the first hint in an English book on acoustics of any difficulty in that subject. In a footnote Mr. Basset clearly states the nature of the assumption usually made, and further expresses his conviction that it is not rigorously true, describing the character of the change in the equations of motion if a more exact theory were adopted. It is a good thing to have mentioned this. The rest of the chapter is devoted to the lateral vibrations of bars. The differential equations are obtained by the use of the stress equations, the idea of the method of formation being taken from a paper by Dr. Besant, and the frequency equations are given for the various cases of ends supported in different manners. Although, perhaps, a discussion of them may be beyond the purpose of the book, we cannot help thinking that a few numerical results would assist in the comprehension of the subject

The two last chapters deal with the theory of waves in air. Chapter ix. contains the formation of the differential equation of vibrations, and a discussion of the value of the velocity of sound as given by Newton and Laplace's suppositions respectively. To explain the latter an account is given of the thermodynamics of gases, leading to the relation of pressure to density when the changes are isentropic.

Chapter x. contains an account of some of the simpler problems of plane and spherical waves. We find here the theory of the notes in a doubly closed pipe, and a short discussion of the forced vibrations produced by attributing an arbitrary periodic motion to a disk at one end of the pipe. The interest of vibrations in pipes lies rather, as it seems to us, in the cases where the pipe has one or both ends open. Even when these are treated as "loops," something may be done towards a theory of organ pipes. The relation of the notes in a "stopped" to those in an "open" pipe is not even given as an example, nor do we find any account of the interesting problem of reflexion of waves in a pipe at the stopped or open ends. The next subject treated is the reflexion and refraction of plane waves at a surface of separation between two gases; this is very nicely worked out, the equations and conditions being very clearly given. The rest of the chapter is occupied with spherical waves. We have here Lord Rayleigh's solutions for (1) purely radial disturbance within a rigid spherical envelope; (2) the vibrations in a conical pipe; (3) the resistance of the air to the motion of an oscillating sphere, and the theory of the scattering of plane waves by a small sphere. The last problem, as here solved, requires the expansion of the velocity potential in a series of spherical harmonics —the only instance in the book of the use of these functions.

The book is well printed and nicely bound. The few blemishes we have had occasion to notice will not seriously diminish its value, and Mr. Basset is to be congratulated on having produced a work that certainly ought to achieve success. A. E. H. L.

LOWNE ON THE BLOW-FLY.

Anatomy, Physiology, Morphology, and Development of the Blow-fly (Calliphora erythrocephala). Part I. By B. Thompson Lowne, F.R.C.S., F.L.S., &c. (London: R. H. Porter, 1890.)

MR. LOWNE'S new work on the blow-fly, of which Part I. has just appeared, requires the serious attention of all who occupy themselves with insect anatomy. It contains the results of a diligent and protracted inquiry, and will teach even specialists a good deal which they did not know before.

Mr. Lowne has written before on this subject. His earlier book (1870) on the blow-fly was the manual of what we may now call a past generation of insect-anatomists, who studied it zealously, and, we fear, often got hopelessly puzzled with its many difficult passages. The present publication is not a new edition, but a totally new work, and the author has only thought it worth while to mention his earlier memoir quite casually in one or two places. The interval of twenty years has enabled Mr. Lowne to make great advances in the knowledge of his subject, and his old treatise on the blow-fly may now cease to be read.

This increase of knowledge is due to laborious microscopic investigation, and to a lengthy, though not exhaustive, study of a literature which is copious, technical, and very largely German. The student has to thank the painstaking author for many new facts, and also for a good deal of information, which, though not new, was previously accessible only to specialists.

Perhaps the most interesting remarks which we have found in Part I. relate to the imaginal disks (it would be better to call them imaginal folds), those curious inward growths of the larval epidermis from which nearly the whole body of the fly is ultimately fashioned. Mr. Lowne's account should be carefully examined by those who have hitherto been content with text-book information, or the descriptions of Weismann, which, original and brilliant as they were, required rectification on a number of special points. We can look forward to a discussion of these imaginal folds far more interesting, and at the same time simpler, than any that present knowledge has produced. Such a type as Corethra (which, by the way, is misquoted as Chironomus in the note to p. 77) shows a slight telescoping of the imaginal antenna within the larval head. Other types, as yet